Question 1

(4 points) [2]

Study the following statements & indicate if they are (**True or False**)

No.	1	2	3	4
Answer	✓	X	X	✓

1. The volume of displaced liquid does not depend on the height of the pontoon.
2. The basket of glass spheres is used to increase the velocity of fluid. ✓
3. If the dimensions of the pontoon do not alter, then BM (distance between center of buoyancy and metacenter point) values are constants for all loading conditions. X
4. In Bernoulli experiment, the height of water in manometers increases as the difference of heights between water surfaces in the two tanks increases.

Question 2

(5 points) [3.5]

A. For each question in the following, choose the correct answer from the multiple-choice list.

No.	1	2
Answer	a	b

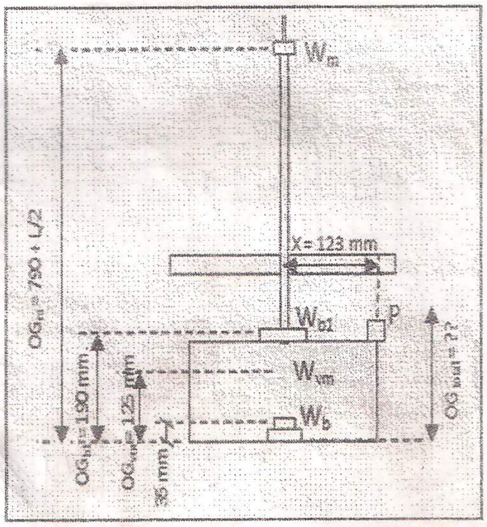
$\frac{200\times35 + 3000\times125 + 300\times190}{3500}$

1. If $W_m = 0$ g, $W_b = 200$ g, $W_{vm} = 3000$ g, $W_{b1} = 300$ g, then $OG_{total} = ...$

   ⓐ 125.4mm b. 146.3mm c. 116.7mm

2. The impact force value on a flat target is .... its value on a hemispherical target for the same flow rate.

   a. larger than ⓑ smaller than c. equal to



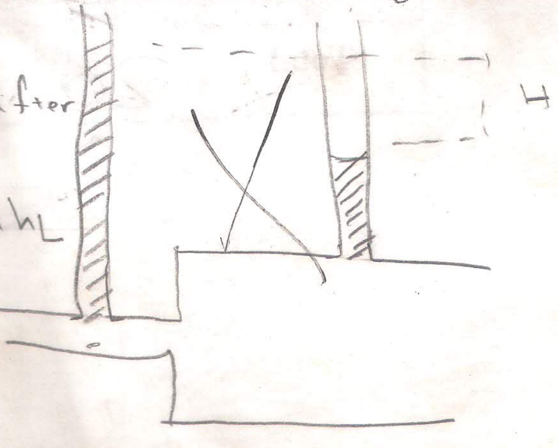
B. Describe by sketch the head in manometer tubes before and after the sudden enlargement apparatus. *Justify your answer?*

apply Bernouli before and after

$$\frac{P_1}{\gamma} + \frac{v_1^2}{2g} + H_1 = \frac{P_2}{\gamma} + \frac{v_2^2}{2g} + H_2 + h_L$$

$v_1 > v_2$

$H_1 > H_2$



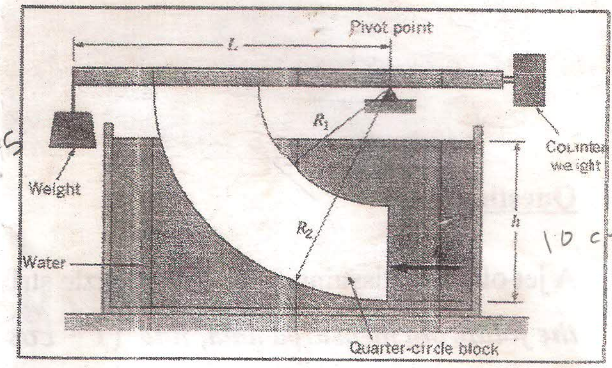
so h_L is diffirence of $TH_{before} - TH_{after}$

Question 3 **(5 points)** 5

For a given water depth *h*, determine the theoretical and practical values of hydrostatic pressure force on the vertical end of the block.

$R_1 = 12$ cm , $R_2 = 20$ cm , b = 6 cm , L = 27.5 cm , W = 175 g , h = 10 cm

$F = 1/2\rho g b h^2$	$F = \rho g \left(h - \frac{d}{2}\right) bd$
$F = \dfrac{WgL}{a + d - \frac{h}{3}}$	$F = \dfrac{WgL}{a + \frac{d}{2} + \frac{d^2}{12\left(h - \frac{d}{2}\right)}}$



$H_w = 10$ cm

a = 12

d = 20 − 12 = 8

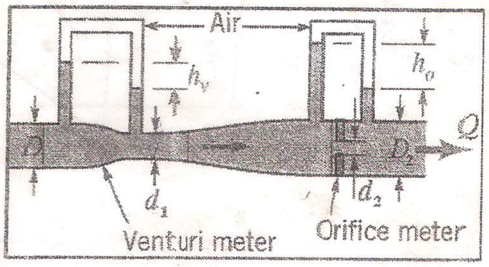
$$F_{act} = \frac{175\times10^{-3} \times 9.81 \times 27.5\times10^{-2}}{12\times10^{-2} + \frac{8\times10^{-2}}{2} + \frac{(8\times10^{-2})^2}{12(10-\frac{8}{2})\times10^{-2}}} = 2.79531\ N$$

$$F_{th} = 1000 \times 9.81\,(10-4)\times10^{-2} \times 6\times10^{-2} \times 8\times10^{-2} = 2.82\ N$$

Question 4 **(5 points)** 4

The water flow through a duct is measured with a venturi meter and orifice meter equipped with manometers. The venturi throat has a diameter (d_1) of 1 cm, and the associated manometers has a differential height (h_v) of 4cm. Taking the discharge coefficient to be 0.98 for venturi meter and 0.62 for orifice plate. ***Determine the differential height (h_o) for the manometers associated with the orifice meter.***

Hint: $D_1 = D_2 = 2$ *cm,* $d_2 = 1.2$*cm* $\quad V_2 = \sqrt{\dfrac{2gH}{1-\left(\dfrac{A_2}{A_1}\right)^2}}$



$$V_2 = \sqrt{\frac{2\times9.81\times4\times10^{-2}}{1-\left(\frac{1^2}{2^2}\right)^2}} = 0.914\ m/s$$

$$Q_{act} = 0.914 \times (1\times10^{-2})^2 \times \frac{3.14}{4} = 7.1822\times10^{-5}\ m^3/s$$

$$Q_{th} = \frac{7.1822\times10^{-5}}{0.98} = 7.3288\times10^{-5}\ m^3/s$$

$-\frac{1}{2}$

$Q_{act} = 0.62 \times 7.18 \times 10^{-5} = 4.543 \times 10^{-5}$

$V_{act} = \dfrac{4.543 \times 10^{-5}}{((1.2 \times 10^{-2})^2 \times 3.14/4)} = 0.3939$ m/s

$V_{act} = \sqrt{\dfrac{2 \times 9.81 \times H}{1 - (\frac{1.2}{2})^4}} \Longrightarrow H = 0.061$ m

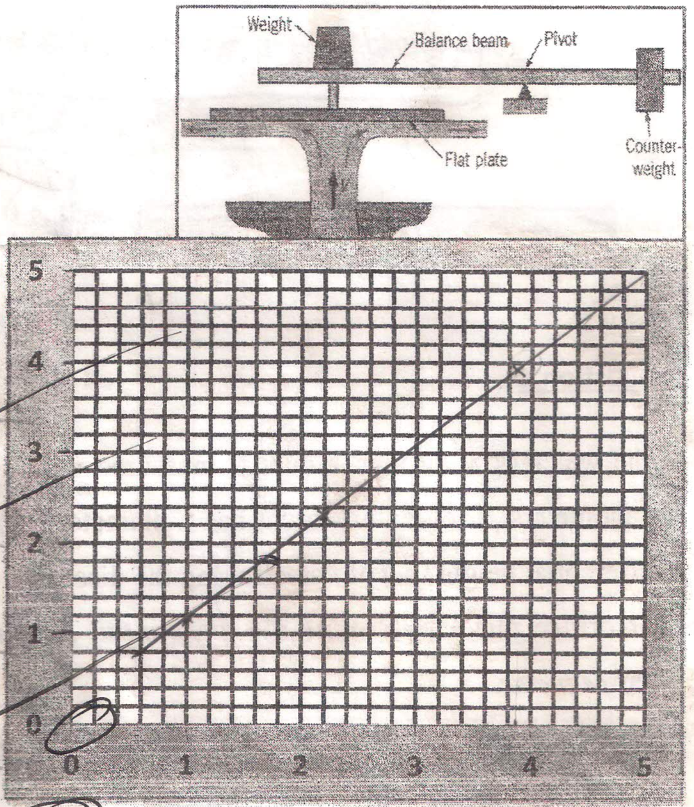
Question 5

(6 points) 5.5

A jet of a fluid issuing from 5mm nozzle striking a flat plate as shown in the figure below. ***Based on the following measured data, find*** $(1 - cos\theta)$***?***

Hint: $R = \rho\, Q\, v_i\,(1 - cos\theta) \qquad v_i^2 = v_n^2 - 2gh$

Height of flat plate above nozzle h (mm)	Additional Weights w (g)	Volume of water collected V (Liter)	Time t (sec)
30	400	33	120
30	230	25	120
30	110	17	120



Q (m³/s)	A_n	V_n	V_i	$\rho Q V_i$	mg
0.275×10^{-3}	1.9625×10^{-5}	0.14×10^{2}	13.991	3.847	3.92
0.208×10^{-3}	1.9625×10^{-5}	0.105×10^{2}	10.58	2.204	2.25
0.141×10^{-3}	1.9625×10^{-5}	0.071×10^{2}	7.177	1.016	1.07

slope actual $= \dfrac{3.92 - 2.25}{3.847 - 2.204} = 1.016$

slop theoritical $= 1 - \cos 90 = 1$